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YU. A. GORIN-KHAST'S CONTRIBUTION
TO THE DEVELOPMENT OF SYNTHETIC RUBBER

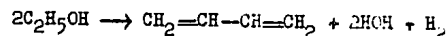
S. V. Rogozhin, Cand Chem Sci

Yu. A. Gorin-Khast was awarded a Stalin Prize, second class (1951), for his work in chemistry.

The USSR is the birthplace of synthetic rubber. Basing his efforts on the theoretical works of A. M. Butlerov, A. Ye. Favorskiy, and other Russian scientists, S. V. Lebedev developed the industrial method of producing rubber from alcohol by the way of butadiene (divinyl).

Ever since the first synthetic rubber plant was set up and up to the present, Soviet scientists have contributed much new material to the science of rubber. The awarding of the rank of Stalin Prize Laureate to Yu. A. Gorin-Khast for his investigations on the catalytic conversion of alcohols to divinyl hydrocarbons, published in Trudy Vsesoyuznovo Nauchno-Issledovatel'skovo Instituta Sinteticheskogo Kauchuka imeni S. V. Lebedeva and Zhurnal Obshchey Khimii during 1949 - 1951, attests to new achievements in this field of organic chemistry.

Butadiene, or divinyl, is at present produced, by Academician Lebedev's method, from ethyl alcohol with the aid of a catalyst. Vapors of ethyl alcohol or a mixture of vapors of alcohol and other carbonyl compounds are passed over a mixed catalyst consisting of a mixture of components which dehydrogenate and dehydrate the alcohol. The process of the conversion of alcohol to butadiene represents a very complex reaction, which can be expressed by the following general equation:



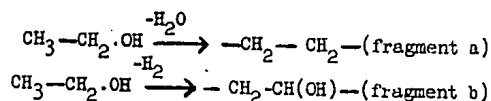
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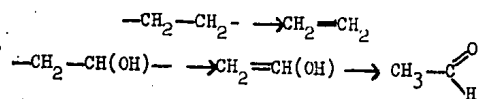
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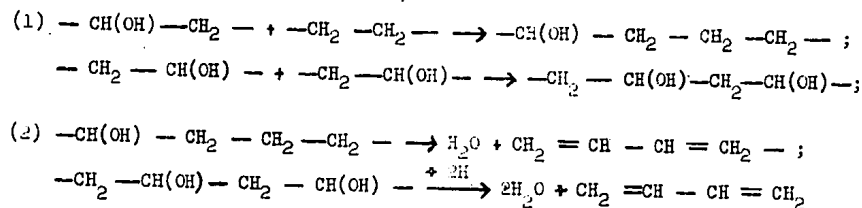
To explain the mechanism of the reaction, Lebedev suggested a scheme at the basis of which was the fact that, during the first stage of the reaction, fragments of alcohol molecules are formed.



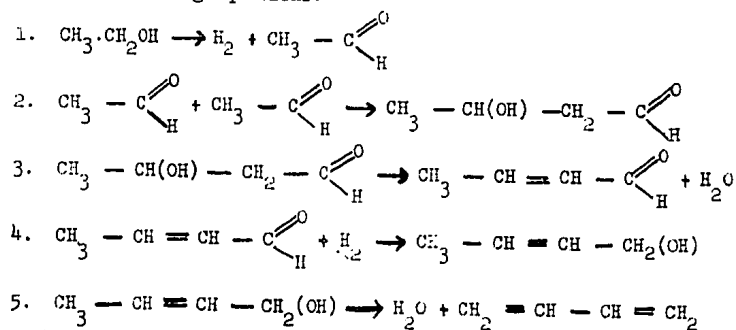
These fragments then take part in further conversions. By natural saturation of the free valences, the fragments are converted to ethylene and acetaldehyde:



Combination of the fragments with each other leads to the formation of more complex reaction products, one of which is divinyl.



On the basis of experimental data, Gorin-Khast suggested another scheme for the conversion of alcohol to divinyl, whereby the alcohol, on the catalyst, is dehydrogenated to acetaldehyde, which is then condensed to aldol. The aldol is dehydrated to croton aldehyde, and the latter, by reduction with hydrogen furnished as a result of the dehydrogenation of the alcohol, is converted into crotyl alcohol. Crotyl alcohol then is dehydrated to divinyl. All this may be shown by the following equations:



Research on the catalytic conversion of a number of alcohols and of their mixtures with carbonyl compounds provided an explanation for the process of formation of all by-products of the reaction, and suggested ways of increasing

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the yield of divinyl. Clarification of the mechanism of the reaction made it possible to use acetaldehyde for the synthesis of divinyl. This is advantageous because acetaldehyde is derived from raw material which is not used for food. Better knowledge of the reaction mechanism also aided in the development of new, more active catalysts which made it possible to increase the yield of divinyl.

The work of Yu. A. Gorin-Khast, which is the result of many years of effort, represents a theoretical development that is of great practical value.

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